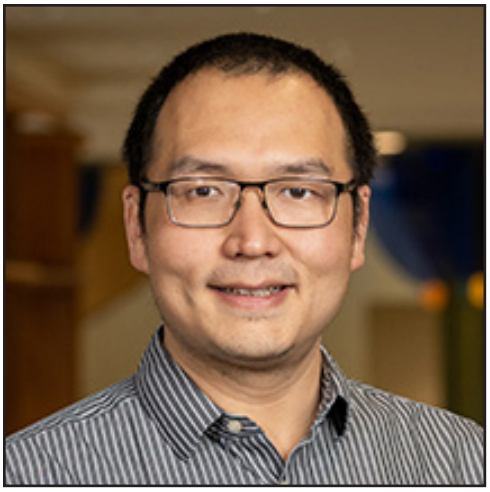
STATISTICS
COLORADO STATE UNIVERSITY

Fall 2025 Departmental Seminar



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12:00 PM
Wagar Building Rm 133

Modern Gaussian Processes for NeuroimagingData Analysis

Abstract

Recent advances in neuroimaging have produced massive and heterogeneous datasets, ranging from fMRI with high spatial resolution to EEG with high temporal resolution, characterized by complex spatiotemporal correlations and substantial inter-subject variability. Traditional regression models and Gaussian process (GP) approaches with fixed parametric kernels often fail to model such complex data effectively while maintaining scalability and interpretability. This talk introduces a family of modern Bayesian GP frameworks that integrate deep kernel learning, neural network priors, and geometric modeling for large-scale neuroimaging analysis. An example is the Deep Kernel Learning Process (DKLP), which embeds deep neural networks within GP priors to learn data-adaptive covariance structures directly from imaging data. DKLP provides a unified modeling foundation for image-on-scalar, scalar-on-image, and image-on-image regression, supported by theoretical guarantees and efficient posterior computation. Applications to fMRI data from the Adolescent Brain Cognitive Development (ABCD) study reveal reproducible cortical activation patterns associated with cognitive ability, while analyses of EEG-based brain–computer interface data demonstrate robust neural decoding under high noise. I will also discuss scalable heat-kernel GPs on manifolds and thresholded GP–based spatially varying neural network priors, which together expand the scope of Bayesian inference for complex neuroimaging data.